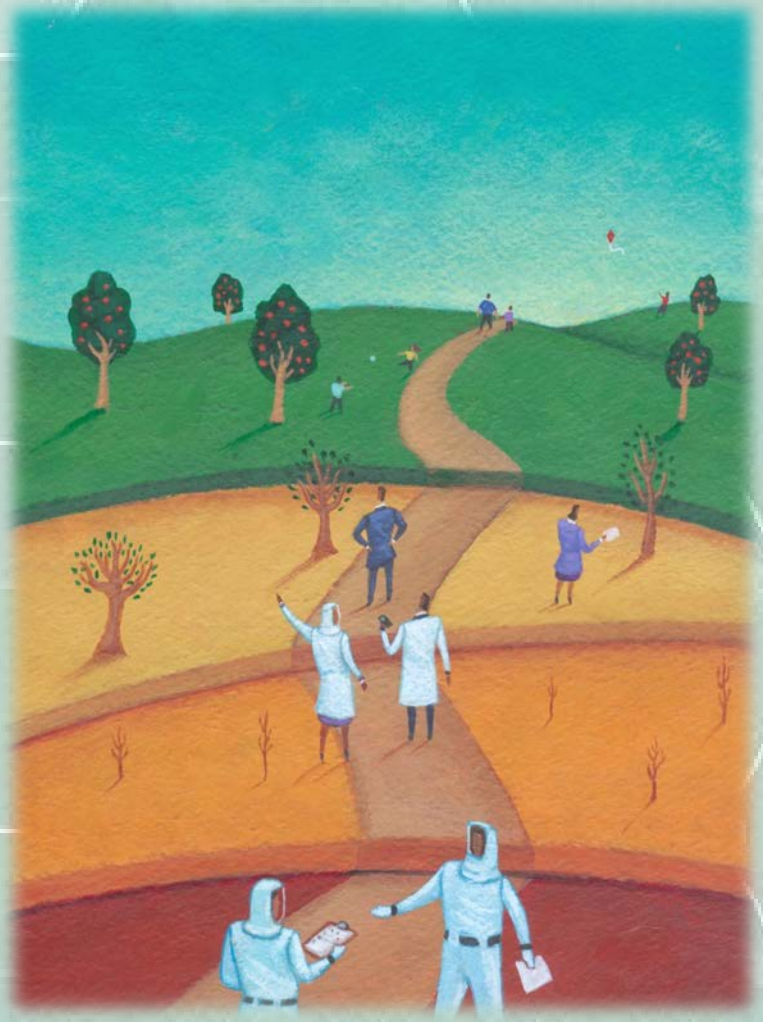
CLEAN PRODUCTION ACTION

Tools for safer chemicals – from chemicals to products to organizations

February 25, 2021



Journey—
safer alternatives to toxic chemicals

- Need to dramatically reduce the risks—the adverse human health and environmental effects—of toxic chemicals
- But preventing exposure to toxic chemicals through the development and use of inherently safer alternatives is difficult
- Therefore need tools that simplify the complexity of toxicity, and guide developers and users to safer alternatives

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Outline

- Clean Production Action (CPA) intro
- Key trends
- Chemical hazard-based tools to reduce risks

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BIZNGO FOR SAFER CHEMICALS & SUSTAINABLE MATERIALS

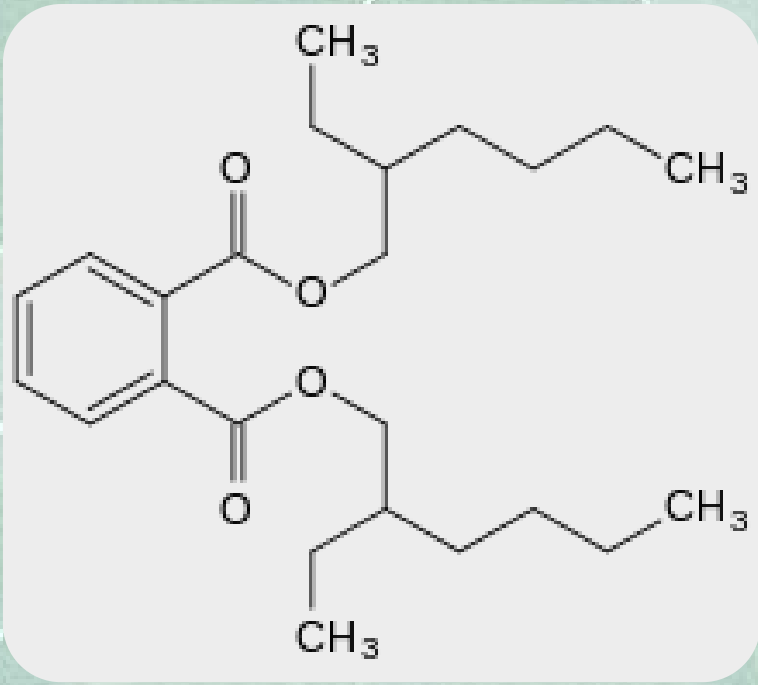
INVESTOR ENVIRONMENTAL HEALTH NETWORK

GREENSCREEN FOR SAFER CHEMICALS

CHEMICAL FOOTPRINT PROJECT

Poll

- Have you heard of any of these chemicals or chemical classes before? Check all that you have heard of before:
  - Bisphenol A
  - Brominated flame retardants
  - Cadmium
  - Lead
  - Organohalogens
  - Per- and poly-fluoroalkyl substances (PFAS)
  - Phthalates



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The production, use and trade of chemicals are growing in all regions

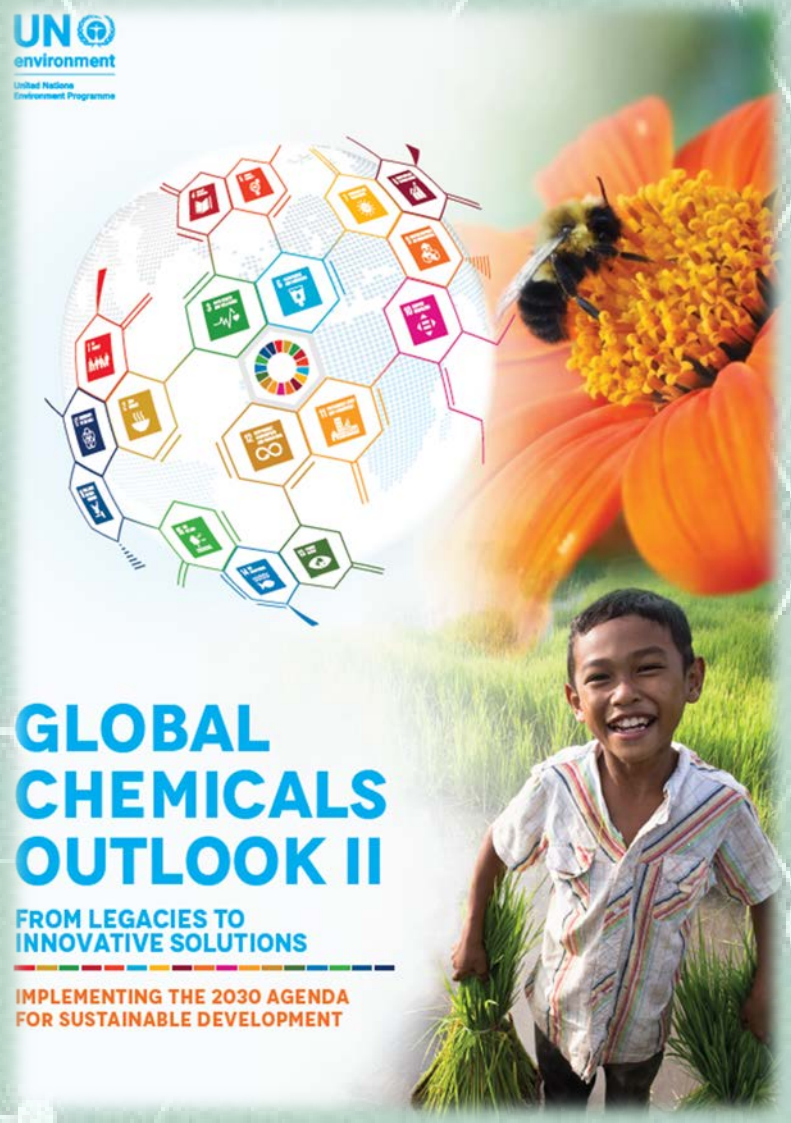
Chemical-intensive products and complex global supply chains create challenges for circularity

Large amounts of chemical pollutants are released from production, products and wastes, illustrating the inefficient use of resources

Chemical pollutants are ubiquitous in the environment and in humans

Chemical pollution threatens biota and ecosystem functions

The burden of disease from chemicals is high, and vulnerable populations are particularly at risk



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Deaths (total: 1.6 million) attributed to selected chemicals in 2016 (adapted from WHO 2018, p. 2)

Endocrine Disrupting Compounds (EDCs)

BOOK by
Leonardo Trasande, MD, MPP
Sicker, Poorer, Fatter: The urgent threat of hormone-disrupting chemicals to our health and future … and what we can do about it
(2019)

- Review of hundreds of studies on EDCs (2020)
- Growing evidence of adverse effects associated with exposure to EDCs — including **per- and polyfluoroalkyl substances (PFAS), phthalates, bisphenols, organophosphate pesticides, and polybrominated flame retardants**.
- Adverse effects include: **obesity, diabetes, cardiovascular disease, IQ loss and intellectual disability, infertility, reduced semen quality, and cancer**

Linda G Kahn, Claire Philippat, Shoji F Nakayama, Rémy Slama, and Leonardo Trasande, "Endocrine-disrupting chemicals: implications for human health," *The Lancet Diabetes & Endocrinology* 8, no. 8 (2020): 703-718, https://doi.org/10.1016/S2213-8587(20)30129-7

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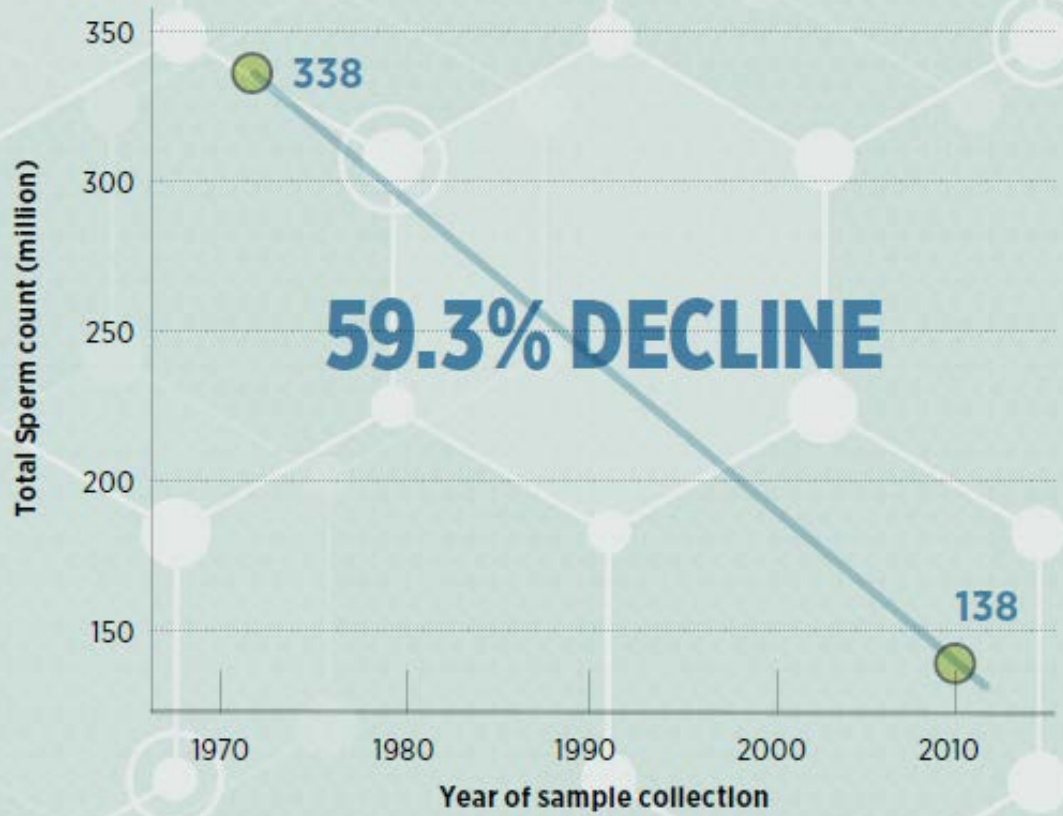
FIGURE 2.
Declining Sperm Count
(Levine et al., 2017)



NEW BOOK by
Shanna H. Swan, PhD
Count Down:
How our modern world is threatening sperm counts, altering male and female reproductive development, and imperiling the future of the human face (2021)

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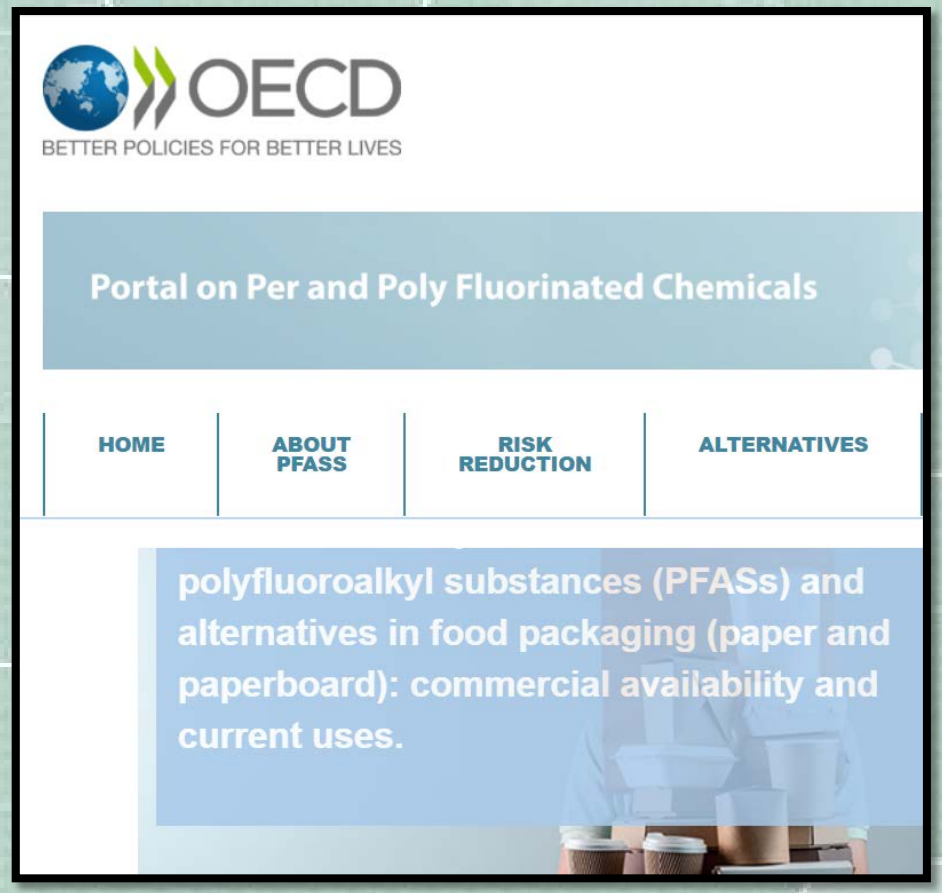
Persistence, Mobility, & PFAS



Persistence as a very important attribute of chemicals and materials (e.g., plastics & PFAS)

Mobile substances are of 'equivalent concern' to PBTs, say scientists

- PMTs (persistent, mobile, and toxic) chemicals
- very persistent, very mobile (vPvM)
- Equivalent to persistent, bioaccumulative and toxic (PBT) substances; and very persistent, very bioaccumulative (vPvB) substances

PFAS and their breakdown products are: very Persistent (vP), mobile (M), and/or toxic

- ~5000 substances = OECD
- Possibly >8000 substances

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Chemical Classes of Concern—*avoid regrettable substitutes*

- Alkylphenols and Alkylphenol Ethoxylates
- Antimicrobials
- Azo dyes
- Bisphenols
- Metals and their compounds (e.g., antimony, cadmium, lead, organotins)
- Phthalates (ortho-phthalates)
- Organohalogens, including PFAS and halogenated flame retardants
- Siloxanes (cyclic volatile methyl siloxanes)
- Solvents (e.g., methylene chloride)

Drivers

- Regulations
- Market demands
- Financial risks

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Trends in Chemicals Management

Hazard assessment: progress in information generation and hazard characterization

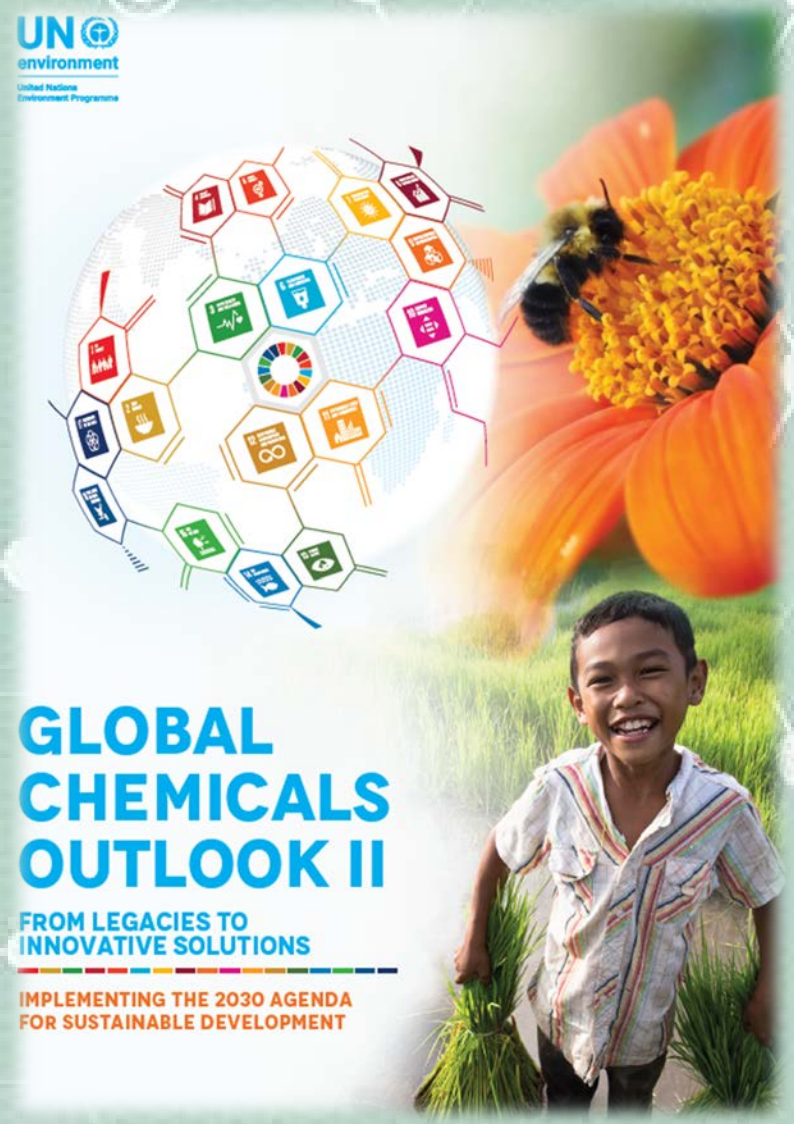
Assessment of chemical and non-chemical alternatives: focusing on solutions

The role of retailers in influencing upstream supply and procurement

The role of downstream product manufacturers and brands

Scaling up effective corporate governance and sustainable supply chain management

Using metrics to track progress and increase accountability



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Q&A

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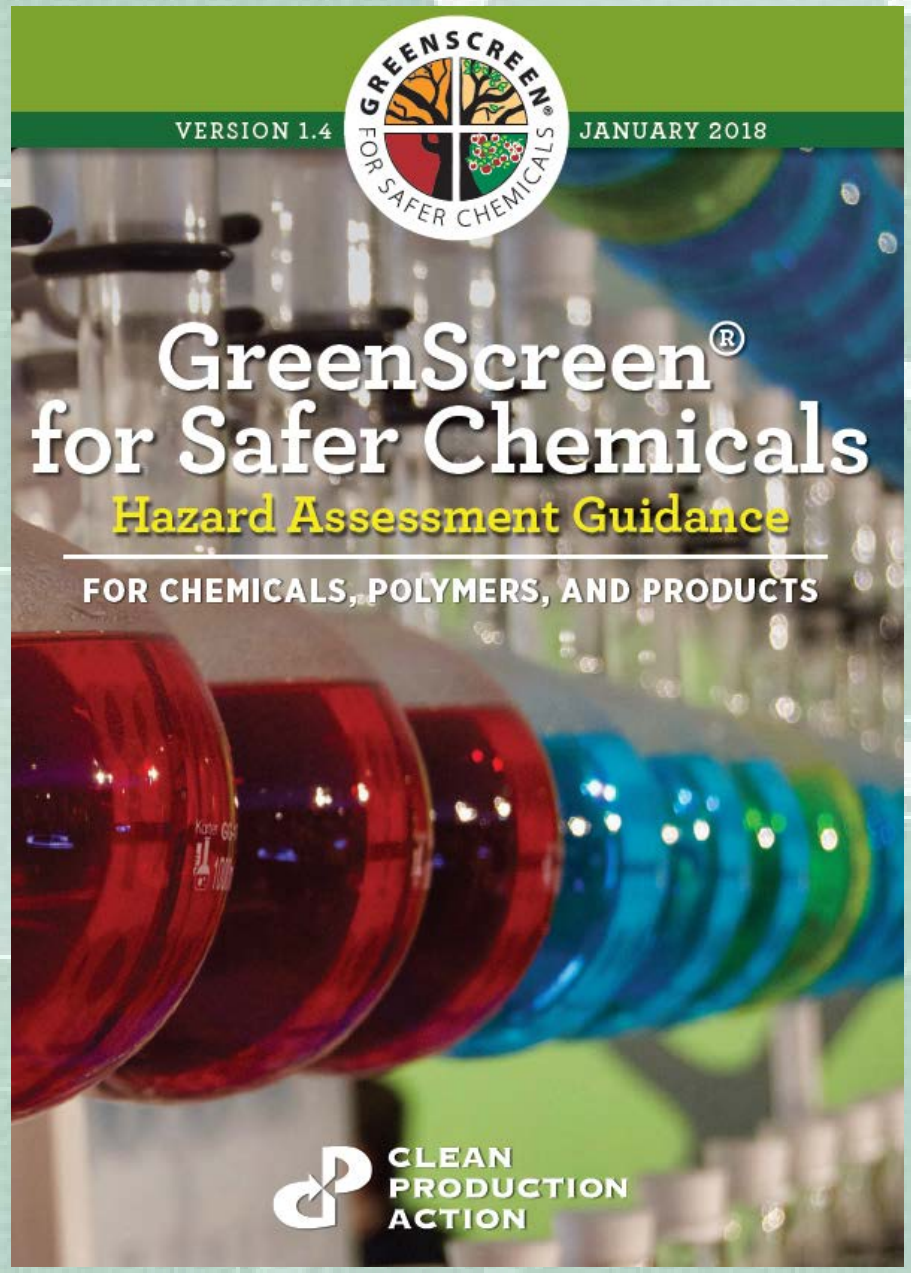
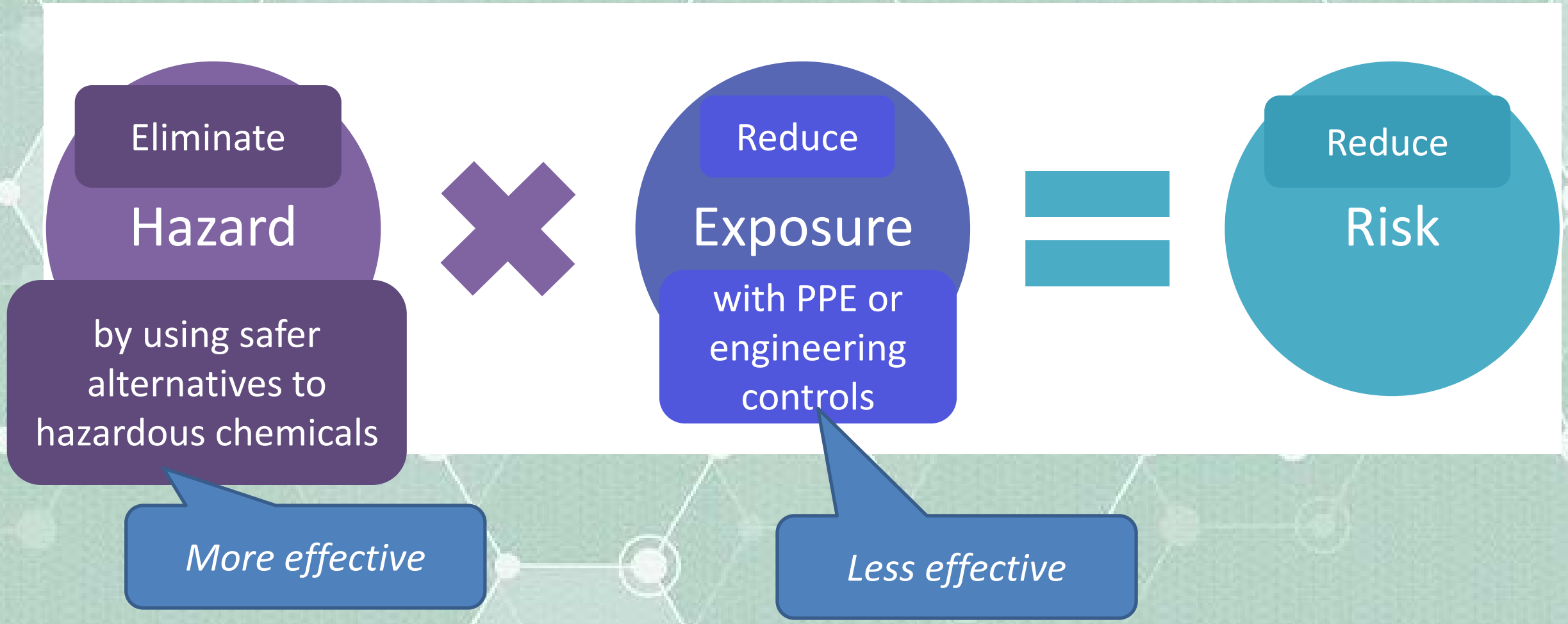
Chemical Hazard Assessment



https://www.greenscreenchemicals.org/learn/full-greenscreen-method

Risk Assessment – dominant chemicals management and regulatory paradigm



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Chemical Hazard-based Tools

Chemical hazard assessment: scores individual chemicals from 1-red to 4-green based on 18 endpoints

2007

Preliminary chemical hazard assessment score based on authoritative & screening lists

2012

Product certification: evaluates all chemicals in a product based on a Restricted Substances List (RSL), List Translator Score, and hazard assessment benchmark score

2017

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GreenScreen Hazard Endpoints

Human Health Group I	Human Health Group II and II*	Environmental Toxicity & Fate	Physical Hazards
Carcinogenicity	Acute Toxicity	Acute Aquatic Toxicity	Reactivity
Mutagenicity & Genotoxicity	Systemic Toxicity & Organ Effects	Chronic Aquatic Toxicity	Flammability
Reproductive Toxicity	Neurotoxicity	Other Ecotoxicity studies when available	
Developmental Toxicity	Skin Sensitization Respiratory Sensitization	Persistence	
Endocrine Activity	Skin Irritation Eye Irritation	Bioaccumulation	

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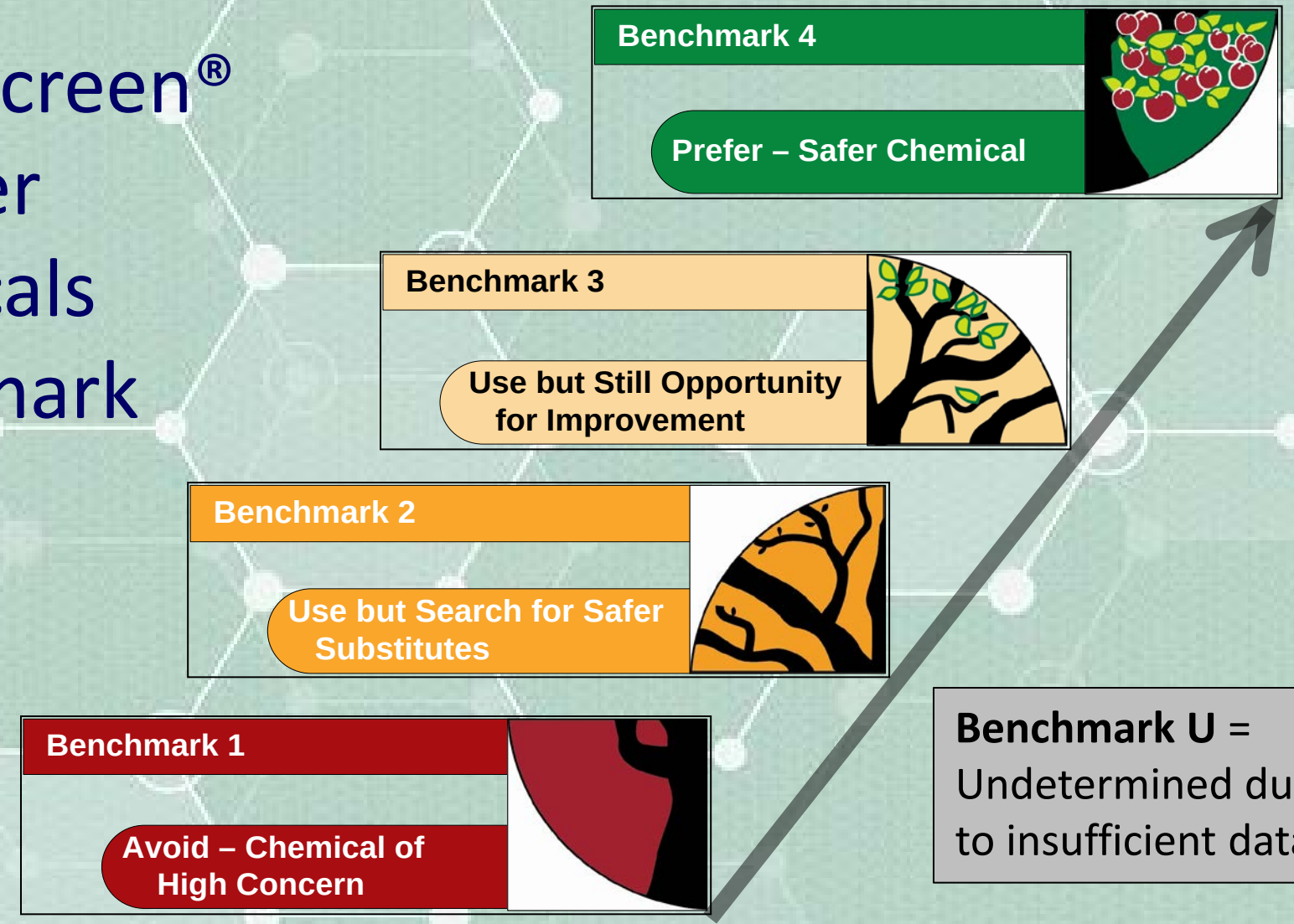
Hazard Assessment

GreenScreen® for Safer Chemicals Benchmark Scores



Benchmark U = Undetermined due to insufficient data

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GreenScreen® Evaluation of Methylene Chloride and Alternatives

Chemical	CASRN	Benchmark Score
Methylene chloride	75-09-2	1
Benzyl alcohol	100-51-6	2
2-(2-butoxyethoxy) ethanol	112-34-5	2
Dimethyl sulfoxide (DMSO)	67-68-5	3
1,3-dioxolane	646-06-0	2
Estasol (dibasic esters mixture)	95481-62-2	2
d-Limonene	5989-27-5	2
Acetone	67-64-1	2
Methanol	67-56-1	1
Toluene	108-88-3	1
Formic acid	64-18-6	2
Caustic soda	1310-73-2	2

CLEAN PRODUCTION ACTION

GreenScreen® Evaluation of Methylene Chloride and Alternatives

		Group I Human					Group II & II Human									Ecotox		Fate		Physical	
Chemical Name	CASRN	C	M	R	D	E	AT	ST		N		SnS	SnR	IrS	IrE	AA	CA	P	B	RX	F
								Single	repeated	Single	repeated										
Methylene chloride	75-09-2	H	NE	DG	DG	M	*M*	*vH*	H	*vH*	*vH*	L	DG	H	H	M	*L*	*vH*	vL	L	L
Benzyl alcohol	100-51-6	L	L	*L*	*M*	DG	M	L	L	*M*	*H*	H	*L*	L	H	L	L	vL	vL	*L*	L
2-(2-butoxyethooxy) ethanol	112-34-5	*L*	L	L	L	DG	L	L	H	DG	L	L	DG	*M*	H	L	L	vL	vL	*L*	M
Dimethyl sulfoxide	67-68-5	*L*	L	L	L	DG	L	L	L	L	L	L	L	*M*	*M*	L	*L*	*L*	vL	*L*	M
1,3-dioxolane	646-06-0	L	*M*	*M*	M	DG	L	M	M	M	L	L	DG	*M*	*H*	L	L	*M*	vL	*L*	H
Estasol (dibasic esters mixture)	95481-62-2	*L*	L	*L*	*M*	*M*	L	M	*M*	M	DG	L	DG	L	*M*	M	*L*	vL	vL	*M*	L
d-Limonene	5989-27-5	L	L	DG	L	DG	L	L	L	DG	DG	H	DG	H	*H*	vH	H	vL	M	*L*	M
Acetone	67-64-1	*L*	L	*M*	M	DG	L	*M*	M	M	*M*	L	DG	L	H	L	L	vL	vL	L	H
Methanol	67-56-1	NA	NA	NA	H	NA	H	vH	NA	NA	NA	NA	NA	NA	NA	L	*L*	vL	*vL*	NA	H
Toluene	108-88-3	DG	L	H	H	M	L	M	H	M	H	L	DG	H	L	H	*H*	*H*	vL	L	H
Formic acid	64-18-6	L	L	L	*L*	DG	H	vH	*H*	vH	DG	L	DG	vH	vH	M	M	vL	vL	L	M
Caustic soda	1310-73-2	*L*	L	*L*	*L*	*L*	H	vH	*L*	*L*	*L*	L	DG	vH	vH	M	DG	*L*	*vL*	*M*	L

TCO Certified Accepted Substance List

Substance name/Trade name	CAS	Type	Benchmark
Aluminum diethylphosphinate	225789-38-8	FR	3
Aluminum Hydroxide	21645-51-2	FR	2
Red Phosphorus	7723-14-0	FR	2
Bisphenol A diphosphate	181028-79-5; 5945-33-5	FR, PL	3

https://tcocertified.com/accepted-substance-list/

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GreenScreen List Translator Automated Tools

toxnot PBC

Pharos

CLEAN PRODUCTION ACTION

Extruded Aluminum Louver with Fluropon Pure Finish by Industrial Louvers Inc.

CLASSIFICATION: 08 90 00

PRODUCT DESCRIPTION: This HPD was based on a model 653XP storm performanc
custom-sized but the material ingredients are the same regardless of size.

Section 1: Summary

Neste

CONTENT INVENTORY

Inventory Reporting Format
- (•) Nested Materials Method
- ( ) Basic Method

Threshold Disclosed Per
- ( ) Material
- (•) Product

Threshold level
- ( ) 100 ppm
- (•) 1,000 ppm
- ( ) Per GHS SDS
- ( ) Per OSHA MSDS
- ( ) Other

Residuals/Impurities
Residuals/Impurities Considered in 3 of 4 Materials

Explanation(s) provided for Residuals/Impurities?
- (•) Yes ( ) No

Are All Subs

Characteriz
Percent We

Screened
Using Priori
Results Dis

Identified
Name and I

hpdc

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MATERIAL | **SUBSTANCE** | *RESIDUAL OR IMPURITY*
GREENSCREEN SCORE | HAZARD TYPE

6063 ALUMINUM EXTRUSION [6063 ALUMINUM (6063 ALUMINUM) LT-P1 | RES | END | PHY] TYPE 3003 ALUMINUM [3003-H14 ALUMINUM (3003-H14 ALUMINUM) LT-P1 | RES | PHY | END] FLUROPON PURE - EXTRUSION [POLYVINYLIDENE FLUORIDE (1,1-DIFLUOROETHENE HOMOPOLYMER) LT-UNK TITANIUM DIOXIDE LT-1 | CAN | END ACRYLIC RESIN NoGS 2,2,4-TRIMETHYL-1,3-PENTANEDIOL DIISOBUTYRATE LT-P1 | END BARIUM SULFATE BM-2 | CAN ACRYLIC-MELAMINE RESIN NoGS TRIPHOSPHORIC ACID, ALUMINUM SALT LT-UNK STRONTIUM CARBONATE LT-UNK SILICA, AMORPHOUS LT-P1 | CAN ALUMINIUM HYDROXIDE OXIDE LT-UNK WOLLASTONITE LT-UNK ZINC 5-NITROISOPHTHALATE LT-UNK ALUMINA TRIHYDRATE BM-2 | RES CELLULOSE ACETATE BUTANOATE, AVERAGE MOLECULAR WEIGHT 15000 - 65000 G/MOL LT-UNK FUMED SILICA, CRYSTALLINE-FREE LT-UNK IRON HYDROXIDE OXIDE YELLOW LT-UNK CHROMIUM IRON OXIDE LT-UNK CHROMIUM (III) OXIDE LT-P1 FERRIC OXIDE BM-2 | CAN CARBON BLACK LT-1 | CAN C.I. PIGMENT BLUE 28 LT-UNK 5,12-DIHYDROQUINO(2,3-B)ACRIDINE-7,14-DIONE LT-UNK PHTHALOCYANINE GREEN LT-UNK 5,12-DIHYDROQUINO(2,3-B)ACRIDINE-7,14-DIONE LT-UNK BISMUTH VANADIUM TETRAOXIDE LT-P1 | MUL C.I. PIGMENT BLUE 15 BM-3 PYRROLO[3,4-C]PYRROLE-1,4-DIONE,3,6-BIS(4-CHLOROPHENYL)-2,5-DIHYDRO- LT-UNK C.I. PIGMENT GREEN 50 LT-1 | RES | CAN | GEN RUTILE, ANTIMONY CHROMIUM BUFF LT-UNK C.I. PIGMENT BLACK 28 LT-UNK C.I. PIGMENT BLUE 36 LT-UNK HEMATITE, CHROMIUM GREEN BLACK LT-UNK MOLYBDATE (MOO42#-), CALCIUM (1:1), (T-4)- LT-UNK NICKEL RUTILE YELLOW LT-UNK 2-(2-BUTOXYETHOXY)ETHANOL LT-P1 | EYE | END] 18-8 TYPE 304 STAINLESS FASTENERS [304 STAINLESS STEEL (304 STAINLESS STEEL) NoGS]

GreenScreen End Users

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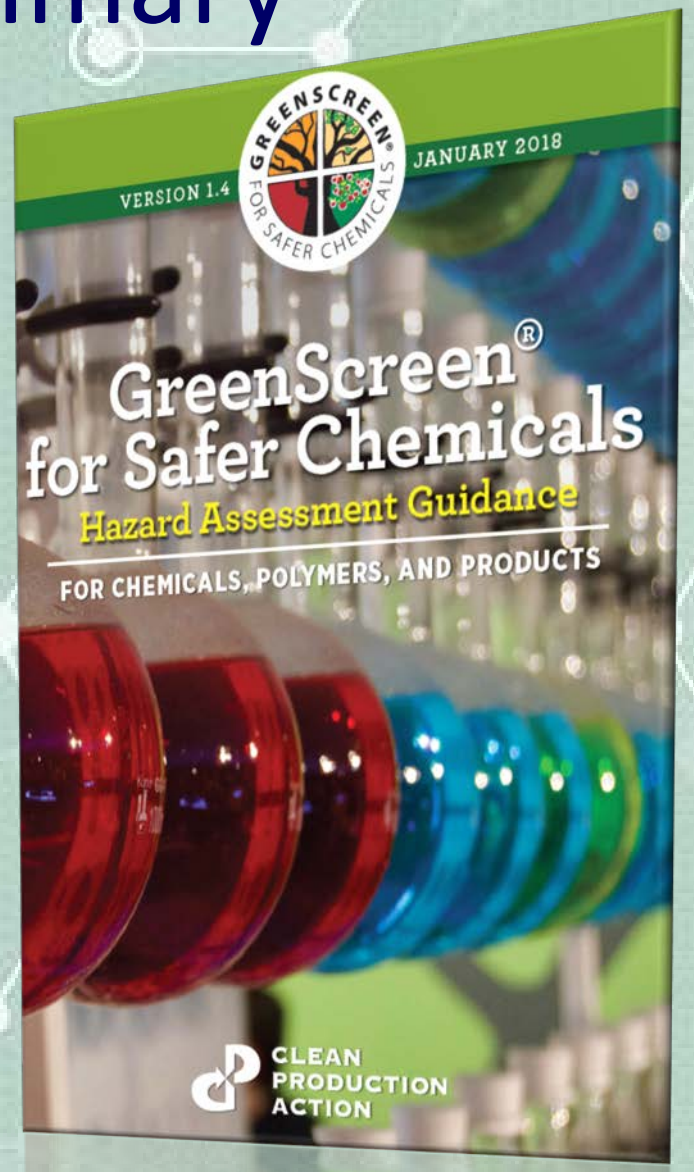
Hazard Assessment Summary

Hazard assessment

- Identify endpoints (e.g., 18 in GreenScreen)
- Specify levels of concern (e.g., High/Moderate/Low) and criteria for each level for each endpoint

Safer chemical

- Roll up endpoints into tiers ranging from high concern (Benchmark-1) to low concern (Benchmark-4)



https://www.greenscreenchemicals.org/learn/full-greenscreen-method

Q&A

CLEAN PRODUCTION ACTION

Product Assessment – based on chemical hazards

- Chemical inventory
- Restricted Substances List (RSL)
- Chemical hazard assessment & elimination of chemicals of concern
- Analytic testing

Purchasers

Manufacturers

Simplify the complexity of toxicity for purchasers & provide manufacturers with incentives for disclosing chemicals in products, assessing hazards of those chemicals, and using safer chemicals

CLEAN PRODUCTION ACTION

GreenScreen Certified™ for Firefighting Foam

1. All chemicals disclosed under confidentiality
2. Product meets Restricted Substances List requirements
3. All chemicals assessed for hazard using GreenScreen hazard assessment or List Translator
4. Product meets analytical testing requirements

Technical Peer Reviewers

Audrey Rossard, Technical Manager, Bio-Ex

Erika Schreder, Science Director, Toxic-Free Future

Holly Davies, Senior Toxicologist, Washington State Department of Health

Ian Ross, Global PFAS Lead, Arcadis

John Payne, Foam Research and Development Manager, Angus International Safety Group

Nigel Holmes, Principal Advisor Incident Management, Queensland Department of Environment and Science

Pamela Miller, Executive Director Alaska Community Action on Toxics and IPEN Co-Chair

Ted Schaefer, Principal Consultant, Global Foam Technology PL

William L. Scogin, President & CEO, Verde Environmental, Inc. (Micro-Blaze)

Chemicals Disclosed under Confidentiality

All chemicals disclosed under confidentiality:

- Intentionally added > 0 ppm
- Impurities > 100 ppm

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Restricted Substances List (RSL)

1. Zero Discharge of Hazardous Chemicals MRSL (manufacturing RSL)
2. Alkylphenols and alkylphenol ethoxylates
3. Siloxanes: Cyclic volatile methyl siloxanes
4. PFAS: Per- and polyfluoroalkyl substances
5. Organohalogens

Product Analytical Testing Requirements

1. Acute aquatic toxicity
2. Total organic fluorine

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Acute Aquatic Toxicity Testing

- Measured on product as sold
- Results required for fish, aquatic invertebrates, and algae
- LC50 or EC50 > 10 mg/L for all three types of organisms

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Total Organic Fluorine Testing

- Measured on the product as sold (i.e., concentrate)
- Samples: Test samples from three different lots or batches
- **Requirement: < 1 mg/kg (< 1 ppm) total organic fluorine**
- Laboratory: international commercial laboratory
- Method: Combustion ion chromatography

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Firefighting Foam:

- Launched in January 2020
- Certified 10 products

Product	Company	Standard	Version	Level
Respondol ATF 3/3: Class B Foam Concentrate	Angus Fire Ltd.	Firefighting Foam	v2.0	Bronze
Jetfoam ICAO-C 6%: Class B Foam Concentrate	Angus Fire Ltd.	Firefighting Foam	v2.0	Bronze
Jetfoam ICAO-C 3%: Class B Foam Concentrate	Angus Fire Ltd.	Firefighting Foam	v2.0	Bronze
ECOPOL: Class B Foam Concentrate	BIOEX	Firefighting Foam	v1.0	Bronze
GREENFIRE® FIREFIGHTING FOAM (GFFF): Class B Foam Concentrate	Fire Suppression Innovations	Firefighting Foam	v2.0	Bronze
UniversalF3 Green 3X3: Class B Foam Concentrate	National Foam, Inc.	Firefighting Foam	v2.0	Bronze
MuniF3 Green Plus 3%: Class B Foam Concentrate	National Foam, Inc.	Firefighting Foam	v2.0	Bronze
AvioF3 Green KHC 6%: Class B Foam Concentrate	National Foam, Inc.	Firefighting Foam	v2.0	Bronze
AvioF3 Green KHC 3%: Class B Foam Concentrate	National Foam, Inc.	Firefighting Foam	v2.0	Bronze
Micro-Blaze Out: Class A&B Wetting Agent	Verde Environmental, Inc	Firefighting Foam	v1.0	Bronze

Summary Product Assessment Requirements for Firefighting Foam

SECTION #	REQUIREMENTS	BRONZE	SILVER	GOLD
6. Product Inventory	Product Inventory includes: a. Additives Inventory: 100% of additives in the product are identified; and b. Chemical Inventory: All intentionally added chemical compounds (present >0 ppm) and impurities present at or above 0.01% by weight (100 ppm) in the additives are identified	✓	✓	✓
7.1 Chemical Hazard Assessment	Intentionally added chemical compounds (>0 ppm) and impurities at or above 0.01% by weight (100 ppm) in the product are screened with GreenScreen List Translator™	✓	✓	✓
	Intentionally added substances (>0 ppm) and impurities present at or above 0.01% by weight (100 ppm) in the product are assessed with GreenScreen		✓	✓
	None of the chemical compounds screened have a GreenScreen List Translator™ score of LT-1	✓	✓	✓
	None of the substances assessed have a GreenScreen score of Benchmark-1[1]		✓	✓
	None of the substances assessed have a GreenScreen score of Benchmark-1, Benchmark-2, Benchmark-2_{DG}, or Benchmark-2_{TP}			✓
	Each substance meets US EPA Master Criteria for Environmental Toxicity and Fate		✓	✓
	Each substance meets US EPA Safer Choice Criteria for Environmental Toxicity and Fate for Chemicals in Direct Release Products			✓
7.2.1 Restricted Substances List	Product meets all Restricted Substances List (RSL) criteria and thresholds	✓	✓	✓
7.2.2 Requirements for Microorganisms	Product meets requirements for microorganisms (if present)	✓	✓	✓
7.2.3 Analytical Testing—Total Organic Fluorine	Product meets analytical testing requirements for total organic fluorine	✓	✓	✓
7.2.4. Analytical Testing—Acute Aquatic Toxicity	Product-level acute aquatic toxicity LC50 or EC50 > 10 mg/L for each of the following groups of organisms: fish, aquatic invertebrates, and algae	✓	✓	✓

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Q&A

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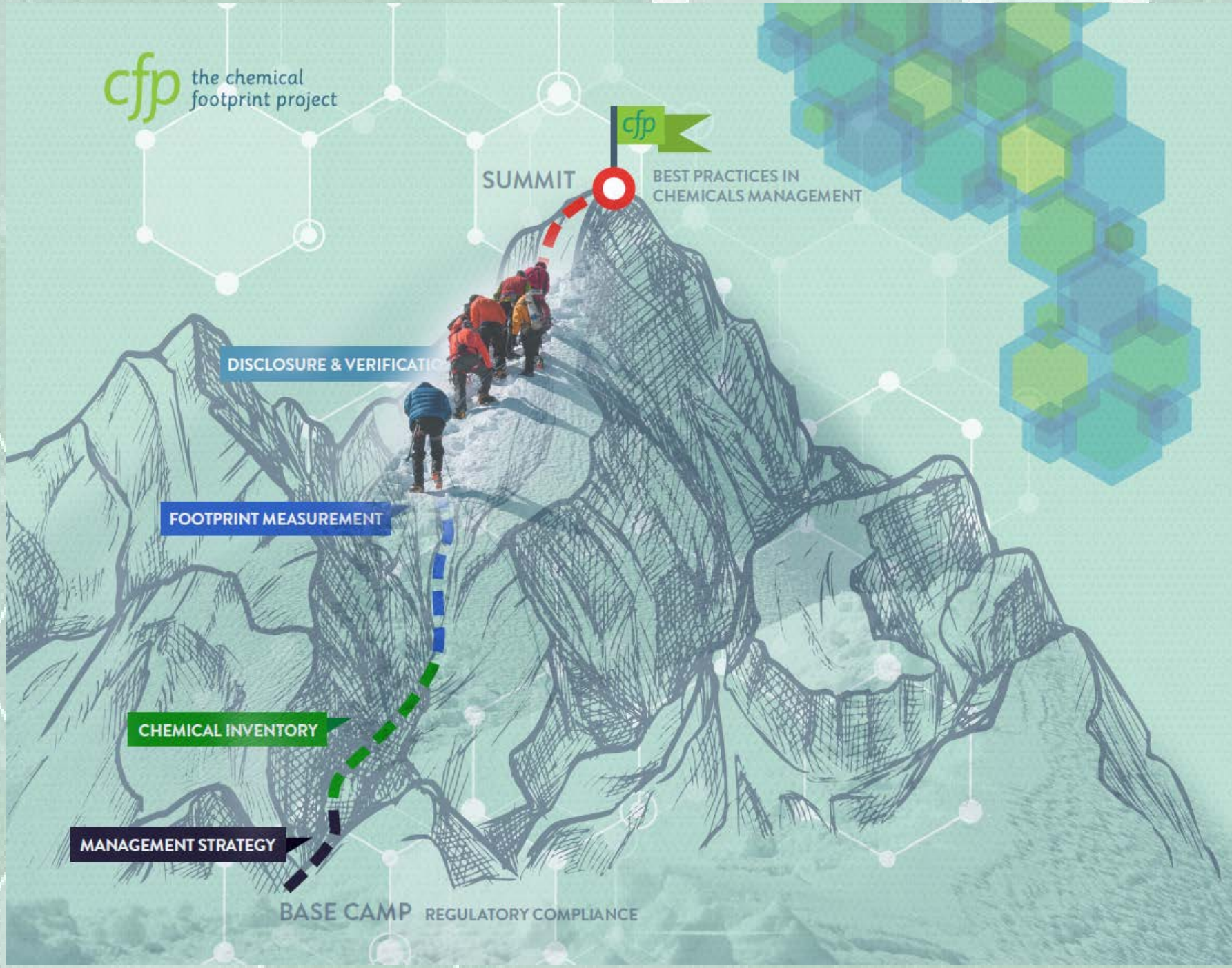
Organization assessment to safer chemicals



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Chemical Footprint Project (CFP) Survey—holistic & hazard-based framework for assessing chemicals management in organizations

MANAGEMENT STRATEGY	CHEMICAL INVENTORY	FOOTPRINT MEASUREMENT	DISCLOSURE & VERIFICATION
20 points	30 points	30 points	20 points
4 questions	6 questions	5 questions	4 questions
26 potential actions	23 potential actions	26 potential actions	11 potential actions

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$2 trillion in assets under management

- Investors = 46
  - Legal & General Investment Management
  - Aviva Investors
  - Bank J Safra Sarasin
  - Parnassus Investments
  - Impax Asset Management
  - Calvert Research and Management

$800 billion in purchasing power

- Health care = 14
- Retailers = 7
  - CVS Health
  - Dollar Tree
  - Rite Aid
  - Staples
  - Target
  - Walmart
  - Whole Foods Market

NGOs = 9
Governments/universities = 2

Signatories total = 78

Apparel & Textiles
- Standard Textile Co.

Building Products & Textiles
- Andersen Windows
- Construction Specialties
- Herman Miller, Inc.
- HNI Corporation
- Humanscale
- Kohler Co.
- Milliken & Co.
- Naturepedic

Hardware
- HP Inc.

Household & Personal Products
- Beautycounter
- The Clorox Company
- Diversey, Inc.
- Ecolab Inc.
- GOJO Industries
- Kimberly-Clark Corporation
- Meliora Cleaning Products
- Reckitt Benkiser Group plc (RB)
- Seventh Generation

Medical Equipment & Supplies
- Becton Dickinson and Co. (BD)
- Steris PLC

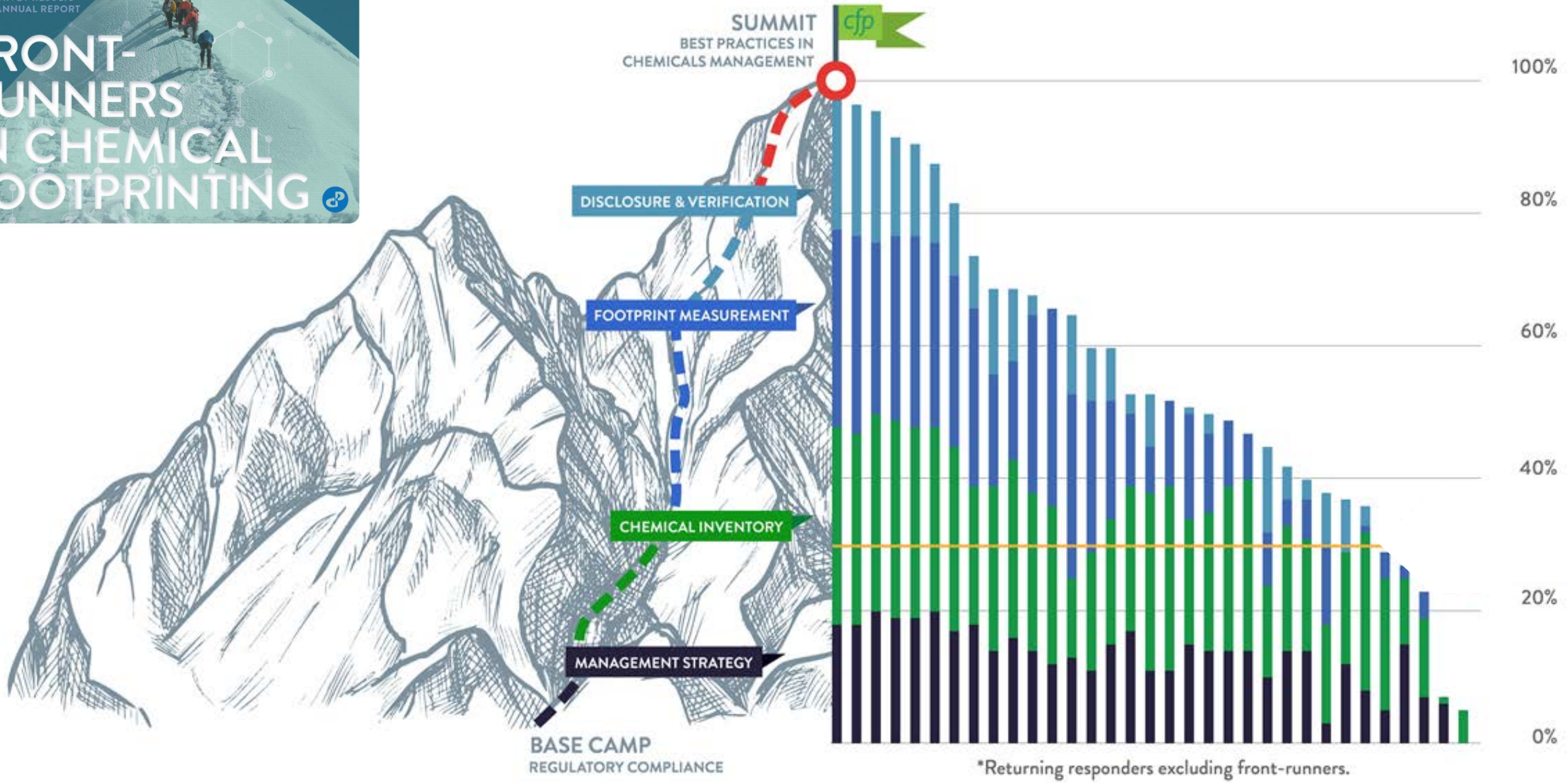
Retail
- Ahold Delhaize
- Dollar Tree, Inc.
- Grove Collaborative
- Target Corporation
- Walmart

Toys
- Hasbro, Inc.
- Radio Flyer

Anonymous: 5 companies

CLEAN PRODUCTION ACTION


CHEMICAL
FOOTPRINT
PROJECT
2020 SURVEY RESULTS
FIFTH ANNUAL REPORT
FRONT-
RUNNERS
IN CHEMICAL
FOOTPRINTING
5
YEARS


SUMMIT
BEST PRACTICES IN
CHEMICALS MANAGEMENT
DISCLOSURE & VERIFICATION
FOOTPRINT MEASUREMENT
CHEMICAL INVENTORY
MANAGEMENT STRATEGY
BASE CAMP
REGULATORY COMPLIANCE
100%
80%
60%
40%
20%
0%
*Returning responders excluding front-runners.

New Responders

MANAGEMENT STRATEGY

Chemicals policy includes reducing chemicals o
chains; and preference for safer alternatives in p

Business strategy includes screening for CoHCs
chemicals/materials

External engagements that support the reducti
and disclosure of chemicals in products

Accountability actions include chemicals manag
senior management responsible for meeting che

CHEMICAL INVENTORY

Restricted Substances List (RSL): has a list of c

Compliance with RSL: trains suppliers about ho

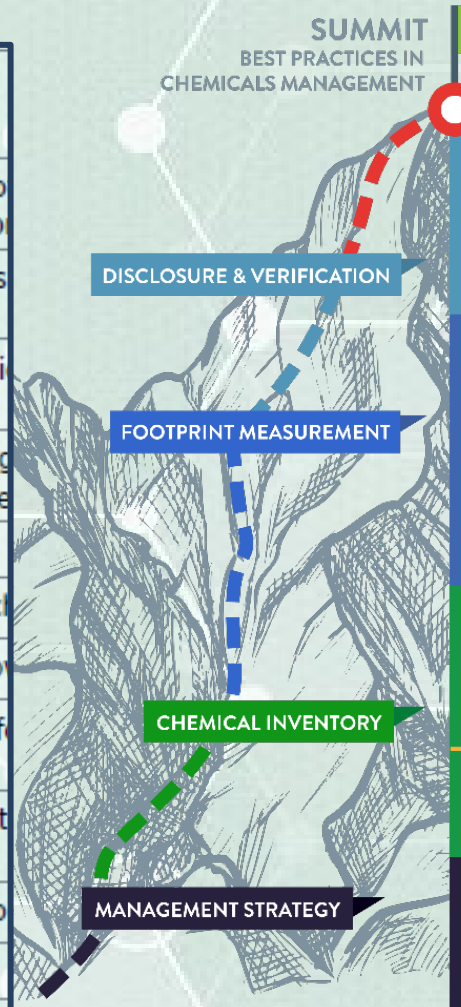
Data collection: collects chemical ingredient inf
requirements

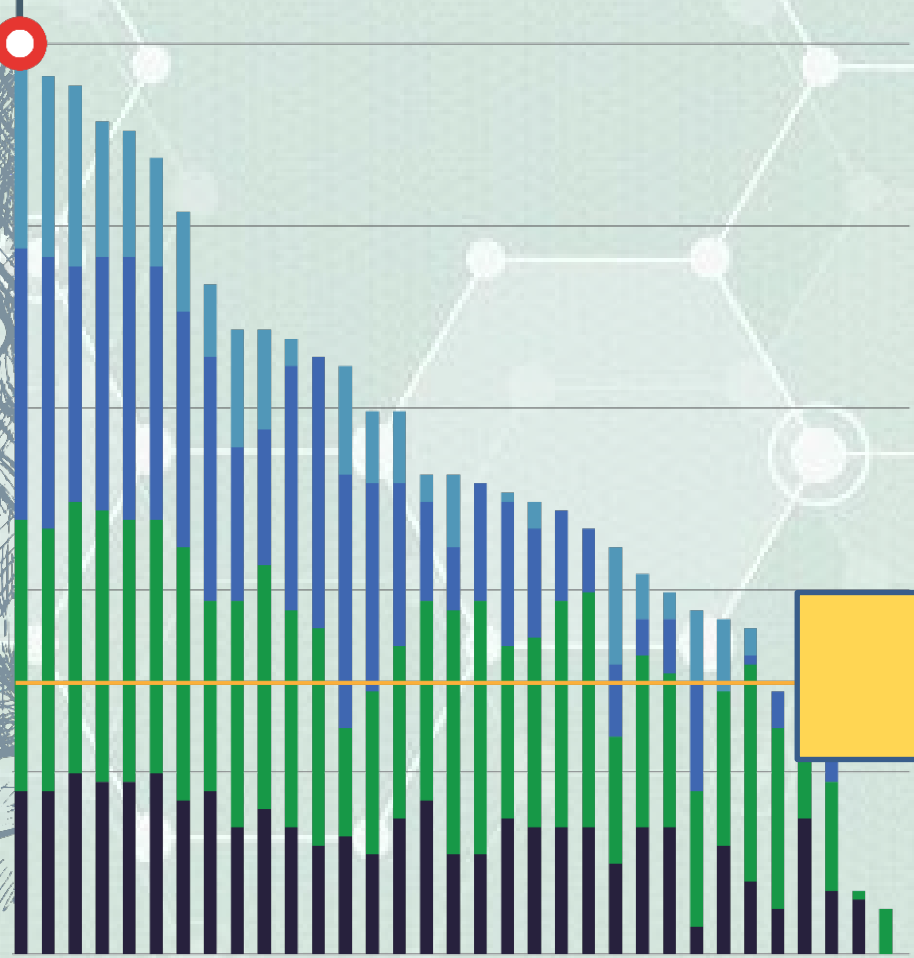
Chemical ingredient data management: has int
chemical information requirements

Supplier conformance: has an audit program to

FOOTPRINT MEASUREMENT

Hazard assessment: uses a system or tool to eva





32%

*Returning responders excluding front-runners.

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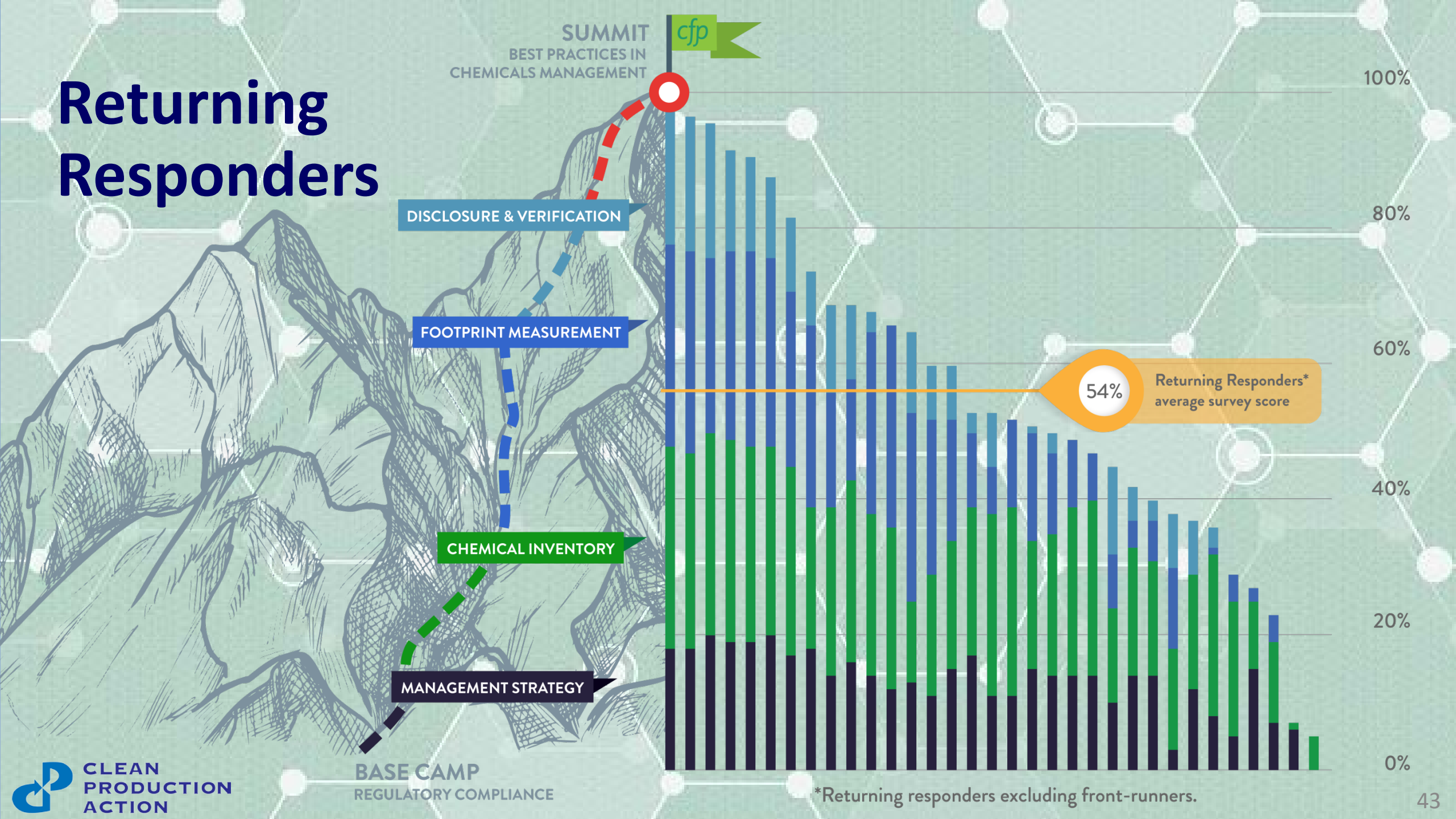
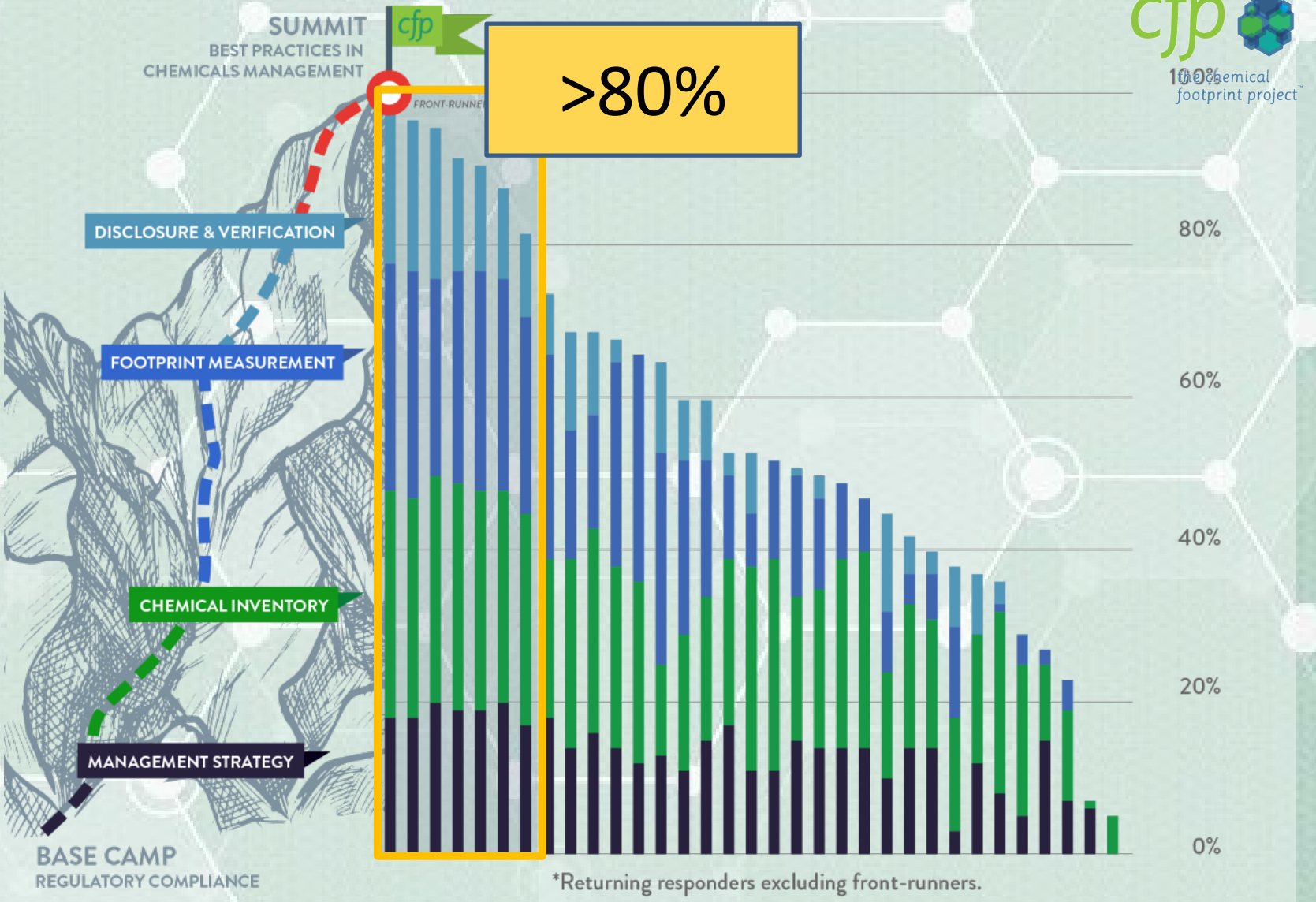
Returning Responders



CLEAN PRODUCTION ACTION

Front-runners

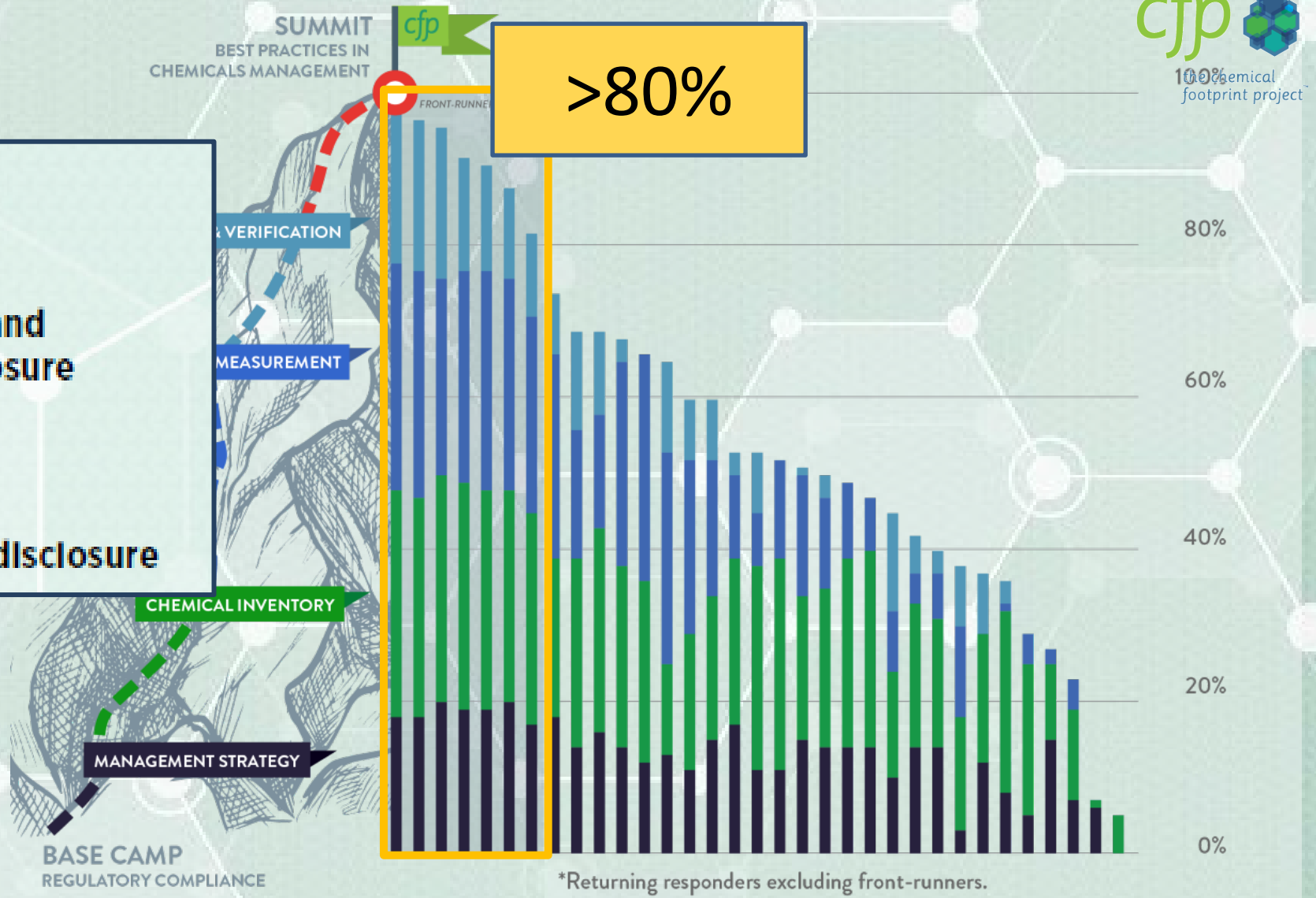
- Beautycounter
- Herman Miller
- HP
- Humanscale
- Naturepedic
- RB
- Seventh Generation



CLEAN PRODUCTION ACTION

Front-runners

- Senior management leadership
- Board level engagement
- Restricted substances list (RSL) and manufacturing RSL (MRSL) disclosure
- Chemical footprint measurement
- Safer alternatives to CoHCs
- CFP Survey responses and score disclosure



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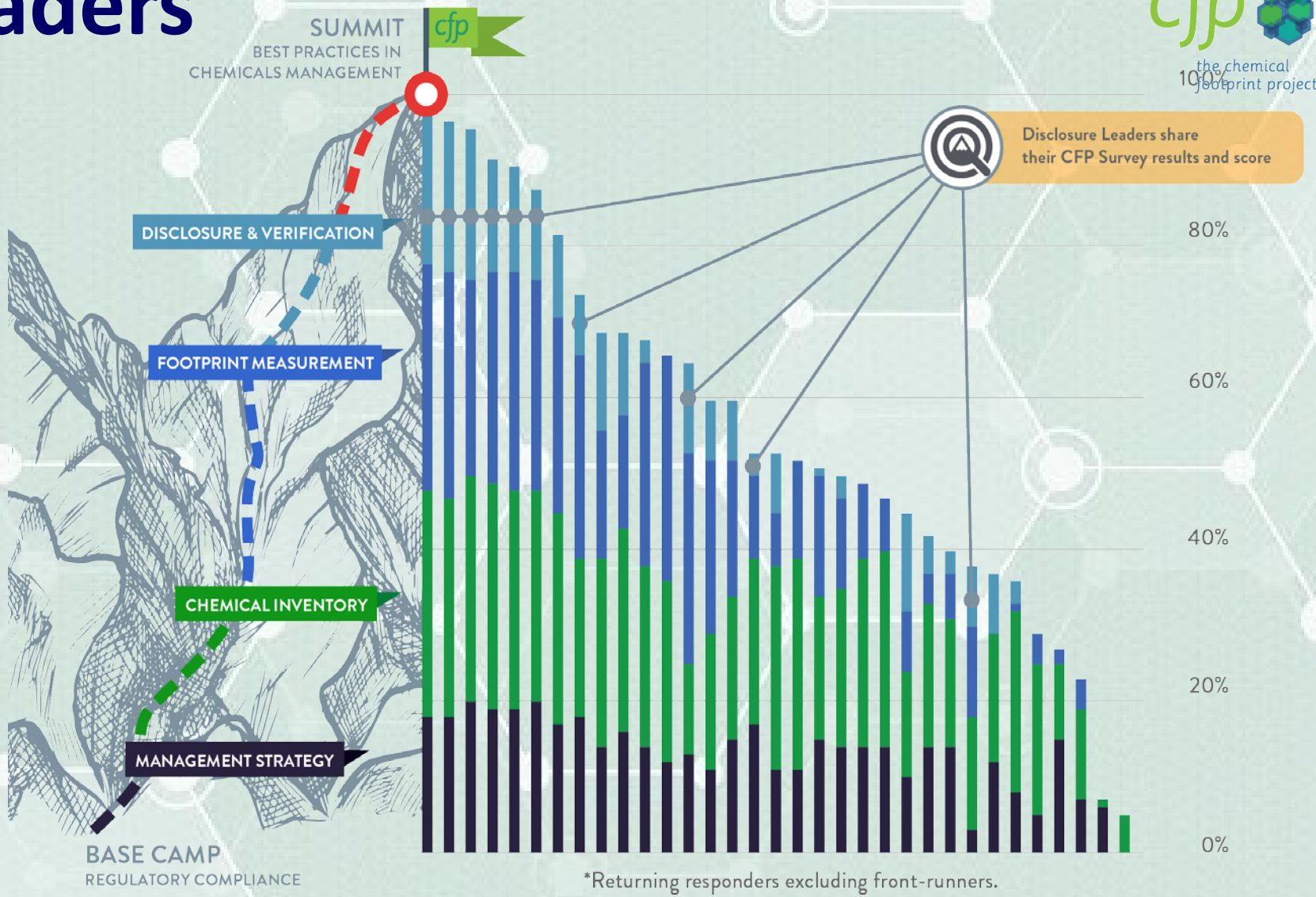
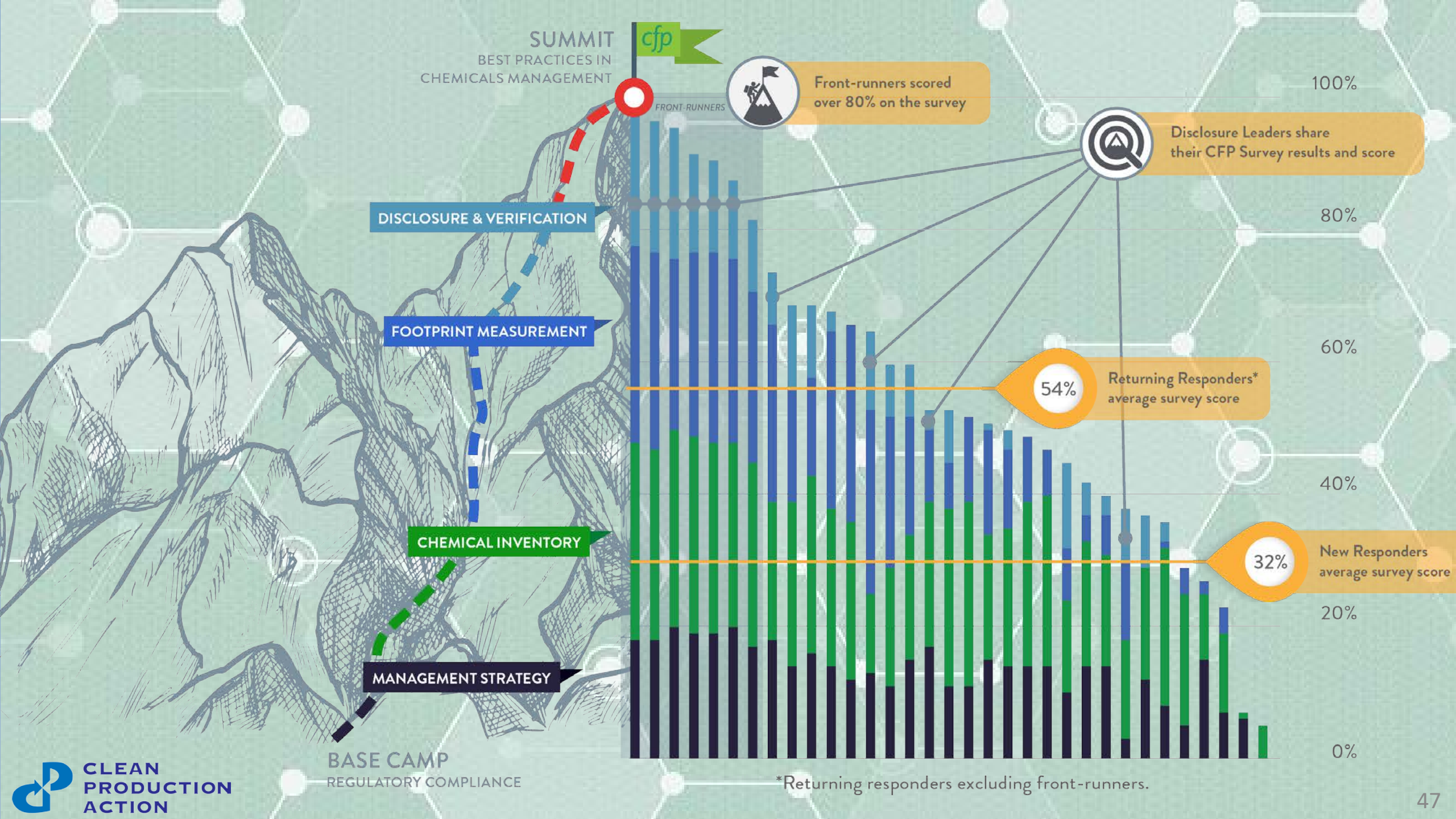
CLEAN PRODUCTION ACTION

Disclosure Leaders

- Beautycounter
- BD
- GOJO
- Herman Miller
- HP
- Humanscale
- Naturepedic
- Seventh Generation
- Walmart

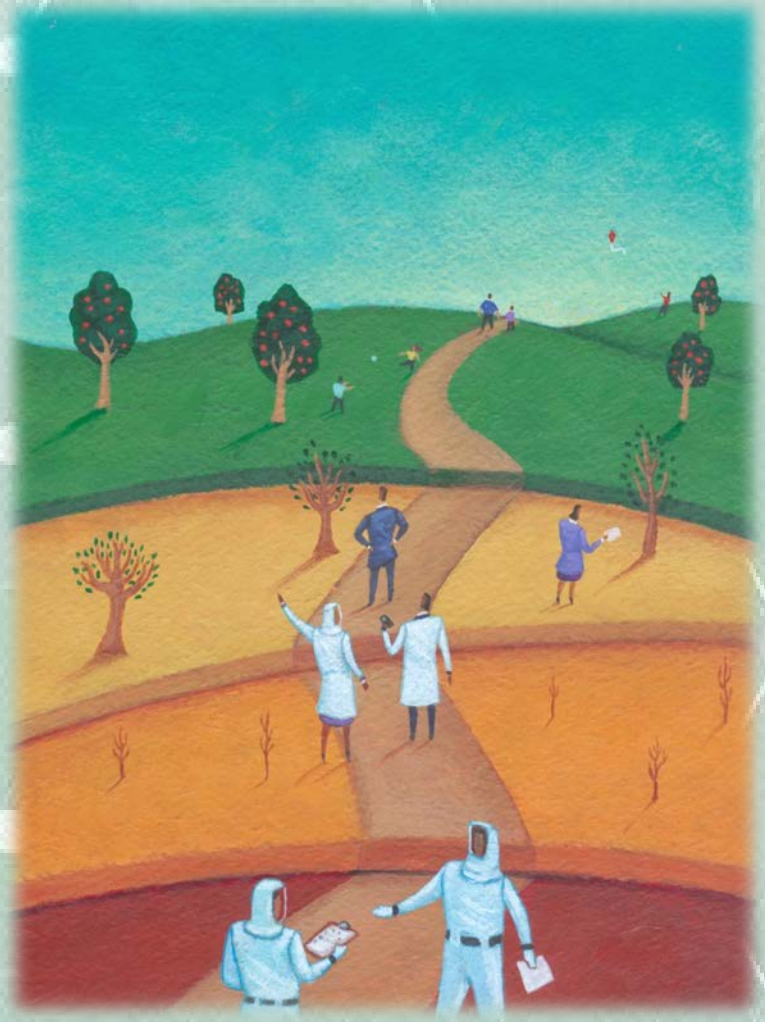


https://www.chemicalfootprint.org/results/disclosure-leaders



CLEAN PRODUCTION ACTION

Summary



Chemical assessment

Product assessment

Organization assessment

CLEAN PRODUCTION ACTION

Thank You! Questions?

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